LONG TERM MODELLING OF PERMAFROST DYNAMICS

REPORT 0004

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The use of soil physical properties such as soil cohesion and soil strength for determining trafficability of soils has been investigated and found to have potential for inclusion in the PERIMO model. The thawing soil condition is especially important because of the opportunity for moisture contents exceeding saturation to occur due to melting of ice. Different soil types can be defined by their strength properties and there has been a small amount of work reported in the literature to link soil strength properties to soil mass movements and soil creep processes. Generally, finer grained soils are more susceptible to ice segregation and therefore the resulting super-saturation that follows thawing which leads to a reduction in soil strength. This avenue could prove important for predictions of both trafficability and mass movement.

A data set for an experiment carried out in Caen has been obtained from Dr. C Harris of Cardiff University. The experiment was concerned with soil creep and gelifluction for four different soil types and was conducted using a laboratory based test slope containing the soils which was subjected to several freeze/thaw cycles. Data is available on profile temperatures and soil creep and gelifluction movements. This data set compliments the data set from the FERF building experiments at CRREL (see report 3) and together with data from the CRREL plots will form a good basis for validation of the PERIMO model.

Recent work has been directed to updating the soil freezing/thawing algorithm in CRREL's Terrain Weather Effects Module (TWEM) for inclusion in the Air Land Battle Environment Tactical Decision Aid system (ALBE TDA). It is important that the structure of this program is kept simple and has parsimonious data demands - for example using weather data supplied on a daily average basis.

The current component is based on a series of regression equations which use total freezing and thawing degree days and snow cover depth to predict depth of freeze or thaw at the chosen location. **Currently no account is taken of soil type or soil moisture content and these factors need to be included for the next version (due for inclusion to ALBE TWEM 31/3/93).**

Input data is cumulative freezing and thawing degree days, average snow depth over the season and current snow depth. The updated version will also have to operate interactively with the Soil Moisture Strength Prediction (SMSP) component of the TWEM scheme. The two modules need to interchange information on soil

moisture content and soil surface condition (which determines if runoff or infiltration will take place).

CRREL have supplied some soils data for freezing which have been processed to supply basic regressions for different soil types. The next step of the strategy is to perform runs of the PERIMO model using input data for a variety of soil types and moisture contents to highlight differences between soil types and moisture content and produce data to create a suite of suitable regressions for the TWEM component. The outline of the program and the necessary data will be sent to Jim Slota (Ohio) who is interfacing the components of the TWEM scheme.

TIMETABLE:

MARCH — Perform PERIMO model runs to produce data to use in formation of regression equations for TWEM component.
Deliver freezing/thawing component to CRREL and Jim Slota, (Ohio).

APRIL — Work on inclusion of volume expansion caused by ice formation.
Possible visit to CRREL.

MAY — Continue work on inclusion of volume expansion.
Incorporate soil strength parameters into PERIMO model for prediction of trafficability and mass movement.